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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/902,483

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Cyril Cabral JR.

YO999-408 CIP

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03/13/2003

MCGINN & GIBB, PLLC
8321 OLD COURTHOUSE ROAD
SUITE 200
VIENNA, VA 22182-3817

EXAMINER

KIELIN, ERIK J

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 03/13/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/902,483

Applicant(s)

CABRAL ET AL. 

Examiner

Erik Kielin

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 06 February 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935-C.D.-11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-8, 10-13 and 23-38 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8, 10-13 and 23-38 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 02 January 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 17.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Drawings

1. The corrected or substitute drawings were received on 2 January 2003. These drawings are approved.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. New claims 27, 29, 31, 33, 35, and 37 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The specification does not provide support for the first silicide phase being silicon-rich. Rather the specification makes clear that the first silicide phase is metal-rich. Moreover, a first silicide phase which is silicon-rich could only become even more silicon-rich during the second reacting step to form the second silicide phase because excess silicon is present with the overlying silicon cap layer. This too is made clear in the specification. (See instant specification, p. 9, lines 4-11.)

For the purposes of patentability, the claims will be interpreted in accordance with the specification --specifically that the first silicide phase is metal-rich rather than silicon rich.

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

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The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 5-8, 23, and 24 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 5-8 are considered indefinite because it is unclear whether the claims refer to the metal alloy or the metal containing silicon. The claims must make clear whether independent claim 4 has been narrowed to refer to metal containing silicon or the silicon alloy. As presently written, it is especially unclear.

For the purposes of patentability, Examiner assumes that the metal deposition refers to either the metal alloy or the metal containing silicon in keeping with independent claim 4.

Claim 7 recites the limitation "said deposition" in line 1. There is insufficient antecedent basis for this limitation in the claim. There are multiple depositions so it is unclear after which deposition the tungsten W is deposited. It appears, however, that Applicant means after the deposition of the metal containing silicon or metal alloy step.

Claim 8 recites the limitation "said metal" in line 1. There is insufficient antecedent basis for this limitation in the claim. Examiner assumes that Applicant means, "metal containing silicon or metal alloy."

Claim 8 recites the limitation "underlay Si" in line 3. There is insufficient antecedent basis for this limitation in the claim. Examiner assumes that Applicant means "underlying bulk silicon substrate."

Regarding claims 23 and 24, it is unclear what is meant by the claims each of which merely states that the first silicide phase is the first forming silicide phase.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1-3, 23, 4-6, 8, 12, 24, 13, 25, 26, new claims 27-30, and 33-38 are rejected under 35 U.S.C. 102(b) as being anticipated by US-5,830,775 (**Maa et al.**).

Regarding independent claims 1, 4, 13, 25, and 26, **Maa** discloses a method for fabricating a silicide for a semiconductor device, comprising

providing a substrate having a silicon layer (Fig. 1) or a bulk silicon substrate (Fig. 3) (col. 4, lines 13-54);

depositing a metal alloy layer **80** (Fig. 4; col. 2, lines 60-67; col. 4, line 62 to col. 5, line 4);

reacting the metal alloy layer **80** to form a first metal-rich silicide phase layer **90**, using RTA (rapid thermal annealing) (Fig. 5; col. 5, lines 5-65);

selectively etching any unreacted metal alloy while leaving behind the metal-rich silicide **90** (Fig. 6; col. 6, lines 29-49);

depositing a silicon cap layer **110** without using epitaxial processes (Fig. 7; col. 6, line 50 to col. 7, line 15);

reacting the cap layer **110** to form a second silicide phase layer (CoSi_2) **122, 124, 126** using RTA (Figs. 8 and 9; col. 7, lines 16-45); and

etching any unreacted silicon cap layer (Fig. 9; col. 7, lines 46-64).

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(See also Fig. 10.)

Regarding claims 2 and 3, as noted above, the substrate may be either bulk or SOI.

Regarding claims 5 and 6, the metal alloy may include Co, Ti, or Ni which is 50 Å to 300 Å thick (5 to 30 nm), which anticipates 7 nm to 8 nm (col. 4, line 62 to col. 5, line 4).

Regarding claim 8, as noted above, the reacting of said metal alloy comprises RTA to form a metal-silicon phase by reaction with the underlying bulk silicon substrate; wherein the etching is selective to remove unreacted metal; wherein the silicon cap layer is blanket deposited; and wherein reacting the silicon cap layer is performed by RTA to form a metal di-silicide.

Regarding claim 12, the source/drain regions are shown to be elevated.

Regarding claims 23 and 24, the first silicide phase is the first forming silicide phase.

Regarding claims 27, 29, 33, 35, and 37, the first silicide phase is metal-rich.

Regarding claims 28, 30, 34, 36, and 38, it is seen to be inherent that the metal alloy extends the temperature window in which a silicide metal-rich phase exists, because Applicant indicates that a window is directly related to quantity of metal present in metal alloy. (See Applicant's specification p. 16, lines 3-8.) In other words, the more metal that is present relative to silicon the longer the window. Consequently if an alloy absent silicon is used, the window is a larger than if silicon is present. See *In re Swinhart*, 169 USPQ 226,229 (CCPA 1971) (where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that subject matter shown to be in the prior art does not possess the characteristics relied on) and *In re Fitzgerald*, 205 USPQ 594 (CCPA 1980) (the burden of proof can be shifted to the applicant to show that

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subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 USC 102 or obviousness under 35 USC 103).

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Maa** in view of Patent Application Publication US 2002/0009856 A1 (**Kanamori**).

The prior art of **Maa**, as explained above, discloses each of the claimed features except for using a TiN or W cap layer to prevent oxidation during subsequent anneal.

Kanamori discloses a virtually identical method to **Maa** and uses a TiN-capping layer over the silicide forming metal which prevents oxidation during annealing.

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use the capping layer of TiN of **Kanamori** in the method of **Maa**, in order to "control the silicide process" as taught by **Kanamori** (paragraphs [0023], [0030], [0038], [0047], [0054]).

10. Claims 10, 31, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Maa** in view of US 5,828,131 (**Cabral, Jr. et al.**).

The prior art of **Maa**, as explained above, discloses each of the claimed features except for indicating if a metal alloy or metal alloy containing silicon was deposited to form the silicide.

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Cabral teaches the benefits of using metal alloys which contain silicon to form silicides on silicon layers. (See Abstract; col. 6, lines 4-16.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to modify **Maa** to use an alloy containing silicon as taught by **Cabral** because **Cabral** teaches that the metal alloy containing silicon provides greater thermal stability to the silicide than the pure metal alone and because **Maa** suggests using other alloys, specifically stating that one of ordinary skill would know what alloys to use. (See **Maa** paragraph bridging cols. 4-5.)

Regarding claim 31, the first silicide phase is metal-rich.

Regarding claim 32, it is seen to be inherent that the metal alloy extends the temperature window in which a silicide metal-rich phase exists, because Applicant indicates that a window is directly related to quantity of metal present in metal alloy. (See Applicant's specification p. 16, lines 3-8.) In other words, the more metal that is present relative to silicon the longer the window. Consequently if an alloy absent silicon is used, the window is a larger than if silicon is present. See *In re Swinhart*, 169 USPQ 226,229 (CCPA 1971) (where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that subject matter shown to be in the prior art does not possess the characteristics relied on) and *In re Fitzgerald*, 205 USPQ 594 (CCPA 1980) (the burden of proof can be shifted to the applicant to show that subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 USC 102 or obviousness under 35 USC 103).

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Double Patenting

11. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b):

12. Claims 1-8, 10-13, 23-38 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 28-31 of U.S. Patent No. US 6,503,833 B1 (*Ajamera et al.*). Although the conflicting claims are not identical, they are not patentably distinct from each other because each teach the same method of forming the silicide regions by dependent a metal containing silicon followed by equivalent process steps.

13. Claims 1-8, 10-13, 23-38 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-50 of U.S. Patent No. US 6,444,578 B1 (*Cabral, Jr., et al.*). Although the conflicting claims are not identical, they are not patentably distinct from each other because each teach the same method of forming the silicide regions by dependent a metal containing silicon followed by equivalent process steps.

14. Claims 1-8, 10-13, and 23-38 of this application conflict with claims 1-30 of parent Application No. 09/569,306. 37 CFR 1.78(b) provides that when two or more applications filed by the same applicant contain conflicting claims, elimination of such claims from all but one application may be required in the absence of good and sufficient reason for their retention

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during pendency in more than one application. Applicant is required to either cancel the conflicting claims from all but one application or maintain a clear line of demarcation between the applications. See MPEP § 822.

Response to Arguments

15. Applicant's arguments with respect to claims 1-8, 10-13, and 23-26 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion


16. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US 5,510,295 (Cabral, Jr. et al.), US 5,608,266 (Agnello et al.), US 5,624,869 (Agnello et al.) each assigned to IBM, each teaches the benefits of using metal alloys to form silicides.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.


Erik Kielin
March 8, 2003